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(54) Title: COMPOSITIONS CONTAINING ENCAPSULATED FOOD ADDITIVE AND THEIR USE

(57) Abstract

Edible compositions comprising encapsulated particles of a food additive which, if not encapsulated, has an undesired effect on other components of a food system. The encapsulation is preferably made of a fatty substance comprising a hydrophilic substance such as glycerol or polyglycerols. In useful embodiments, the encapsulated food additive is a preserving agent having an inhibitory effect on yeast or microbial food starter cultures, an enzyme or a compound, the presence of which in a food system causes gelling agents to gel or stabilizing agents to modulate the viscosity. Specifically, the composition is a dough improving composition comprising a preserving agent including propionic acid and salts thereof.

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COMPOSITIONS CONTAINING ENCAPSULATED FOOD ADDITIVE AND THEIR USE

FIELD OF THE INVENTION

The present invention relates to the field of processing of food systems such as flour doughs that include a food additive which has an undesirable effect on another component present in the food system.

TECHNICAL BACKGROUND AND PRIOR ART

In many instances is it desirable to include a food additive in a food system including e.g. a flour dough system with the aims of obtaining the particular effect associated with that food additive. However, such a food additive, the addition of which is desirable in respect of a particular effect in the food system either during the preparation of such a system, during the processing hereof or in the finished food product resulting from processing the food system, may have an undesirable effect on other components of the food system.

Presently, such undesired interactions between components in a food system can be avoided by selecting alternative components which, however, may be less suitable than those interacting with each other, or the undesired effect caused by a given food additive is compensated for by adding the component on which the food additive has an undesired effect in higher amounts than would be required if such an undesired effect did not occur. Alternatively, less than the optimum amount of the food additive can be used with the unavoidable effect, however, that the desired effect of such an additive cannot be fully utilized.

Thus, as a typical illustrative example of such a problem it may be desirable to add a preserving/antimicrobial agent to a food system with the objective of extending the shelf life of the finished food product. However, when the processing of

such a food system includes that a viable culture of a micro-organism is added to the food system to obtain a desired effect as the result of the metabolic activity of the culture, this activity may become reduced or may not occur at all due to the inhibitory effect of the preserving agent on the microbial culture. Therefore, it may, as indicated above, be necessary to add a less effective food additive or, as alternatives, to reduce the amount hereof to levels which does not secure the best possible shelf life extension or add a higher amount of the microbial culture so as to at least obtain some effect hereof in the presence of the food additive.

The undesirable interaction effect may also be an interaction between a food additive and another chemical food system component which results in an undesired structural or functional modification of such a component at a point in time where the occurrence of such modifications are not appropriate.

A primary objective of the present invention is to provide the means of preventing that undesirable interactions between a food additive and other components of the food systems occur, at least during part of the processing of such systems.

SUMMARY OF THE INVENTION

Accordingly, the invention pertains in a first aspect to an edible composition comprising a food additive component which, when it is brought into contact with a second component present in a food system to be processed, at least during part of the processing time, has an undesirable effect on said second component, said food additive component being in the form of particles encapsulated by an encapsulation structure preventing that the food additive initially is brought into contact with the second component, the encapsu-

lation being degradable at a later point in time under pre-selected conditions during the processing of said food system, whereby, as a result of the food additive component initially being encapsulated, the undesirable effect on the second component can be avoided at least during part of the processing time for said food system, said encapsulating structure comprising an edible fatty component comprising a hydrophilic substance which does not in itself provide an encapsulation but which improves the characteristics of the encapsulation.

In a further aspect of the invention there is provided a method of producing a food product, comprising processing a food system comprising a composition as defined above and one or more further component(s) on which the food additive component of the composition has an undesirable effect, under conditions where the encapsulation is degraded at a later point in time under pre-selected conditions during the processing of said food system, whereby, as a result of the food additive component initially being encapsulated, the undesirable effect on the second component can be avoided at least during part of the processing time for said food system.

In yet other aspects the invention pertains to a dough improving composition comprising a dough additive component which, when it is brought into contact with a second component present in a dough system to be processed, at least during part of the processing time, has an undesirable effect on said second component, said dough additive component being in the form of particles encapsulated by an encapsulation structure preventing that the dough additive initially is brought into contact with the second component, the encapsulation being degradable at a later point in time under pre-selected conditions during the processing of said food system, whereby, as a result of the dough additive component initially being encapsulated, the undesirable effect on the second component can be avoided at least during part of the

processing time for the dough, said encapsulating structure comprising an edible hydrocolloid, an edible polymer and/or an edible fatty component comprising a hydrophilic substance which does not in itself provide an encapsulation but which improves the characteristics of the encapsulation, and to a method of preparing a baked product, said method comprising that a dough improving composition as defined above is added to a dough, and baking the dough.

DETAILED DISCLOSURE OF THE INVENTION

The edible composition according to the invention comprises a food additive component in the form of particles which are encapsulated by an encapsulating component providing an encapsulation structure which is degradable or disintegratable at conditions occurring during the processing of a food system to which the edible composition is added. When the encapsulation is degraded/disintegrated or broken down, the food additive component is released into the food system and can thereby exert its intended food additive effect.

The term "food additive" is used herein in its conventional meaning and the skilled person will understand that it includes at least the following major groups of additives, the utility and effects of which are well-known in the art: antioxidants, sweeteners, flavourings, colours, preservatives, enzymes, nutritive additives such as vitamins and minerals, emulsifiers, pH control agents such as acidulants, hydrocolloids, antifoams and release agents, flour improving or strengthening agents, raising or leavening agents, gases and chelating agents.

In most industrial food manufacturing one or more food additives is/are incorporated into the food system prior to processing. In the present context, the expression "food system" refers to a mixture of all the ingredients of a particular food product prior to the processing steps which

result in the finished food product. Typically, such processing steps include a heating step such as boiling, frying, microwave cooking or baking. Thus, it will be understood that in this context, a food system includes a flour dough system.

Whereas food additives are added to food systems with the objective of obtaining certain desirable effects during processing of the food systems or in the finished food product such as e.g. a preserving effect, a viscosity or consistency controlling effect, an emulsifying effect, an enzymatic effect or a dough or bread improving effect including an increased bread volume or an extended shelf life, food additives may also under certain conditions exert undesired effects on other components of the food system during the processing hereof.

The desired effect of a food additive may in many instances not be absolutely required during early stages of the food system processing. This is e.g. the case when the desired effect is one which should primarily occur in the finished food product resulting from the processing of a food system such as e.g. a shelf life extension or a preserving effect with the aims of controlling microbial spoilage. It may also be the case when the occurrence of an effect including a particular consistency regulating effect such as e.g. a thickening effect, a viscosity enhancement effect, a gelling effect or an enzymatic effect is not required or is even undesired during initial stages of the food system processing.

In such instances the effect of a given food additive which, in addition to its intended, useful effect, may have an undesired effect on other components of a food system can therefore be deferred without disadvantageous implications for the food system.

In accordance with the invention this deferment is achieved by providing the food additive component of the edible compo-

sition in the form of particles which are encapsulated by an encapsulating component providing an encapsulation which is degradable/disintegratable or can be broken down under certain conditions occurring during the food system processing.

As used herein, the expression "degradable or disintegratable" refers to any physical or chemical condition under which the encapsulation is broken down or disrupted to an extent that permits the food additive component to become released to exert its food additive effect. Thus, the encapsulation may e.g. be disintegrated by heating to above its melting point, by dissolution or by enzymatic degradation. It will be understood that the terms "encapsulating" and "encapsulation" are equivalent to the term "coating" which is frequently used in the art.

Cultures of selected microorganisms are, as it is mentioned above, used conventionally as components of many food systems to confer a desired effect during processing or subsequently during storage of the finished food product. Such cultures include viable cultures of selected bacterial, fungal and yeast species. Well-known examples of such useful selected bacterial species include lactic acid bacterial species such as *Lactococcus* spp., *Lactobacillus* spp., *Leuconostoc* spp., *Pediococcus* spp. and *Streptococcus* spp., and *Bifidobacterium* spp. Starter cultures of these bacterial species are used extensively in the manufacturing of dairy products, meat products, wine and fruit juices, bread products and vegetable products.

Another example of microbial culture components which are useful in the food industry are cultures of filamentous fungi such as e.g. *Penicillium* spp. which are used in the manufacturing of cheese and other dairy products.

Likewise, viable cultures of yeast is commonly used in food manufacturing in the form of baker's yeast as leavening agent

in dough systems, distiller's yeast, brewer's yeast and as wine fermentation cultures.

To obtain the maximum effect of viable microbial cultures in food systems it is generally required that the conditions herein permit good survival, growth and/or metabolic activity of the cultures.

Accordingly, in one embodiment, the composition according to the invention comprises a food additive component which is a compound having a limiting effect on the desired function of viable cells in a food system, including a compound which has an inhibitory or biocidal effect on second component viable microbial cells.

A typical example of such a food additive compound is a preserving agent which may also be referred to as an antimicrobial agent. Preserving agents which are commonly permitted for use in food manufacturing and which can be used in accordance with the invention include sorbic acid, sorbates, benzoic acid, benzoates, parabens including methyl, ethyl, propyl and heptyl parabens, propionic acid, propionates, nitrous acid, nitrites, SO_2, sulphites and bacteriocins such as nisin. Several other agents which may be used for other purposes in food systems exert an antimicrobial preservative effect, e.g. hydrogen peroxide, sodium chloride, EDTA, butylated hydroxyanisole (BHA), butylated hydroxytoluene (BHT), tertiary butylhydroquinone (TBHQ) and propyl gallate (PG). Such food additive agents or compounds from which they can be generated during processing of food systems are also encompassed by the invention.

Whereas it is particularly advantageous to provide the above food additives in the form of the composition according to the invention in food systems comprising viable microbial cultures, with the objective of deferring or preventing inhibitory effects on such cultures, it is contemplated that the provision of the additives as encapsulated and therefore

initially inactive particles may also be advantageous in other respects, e.g. with respect to deferment of oxidizing effects, pH decrease or undesired sensory effects.

One specific example of the advantageous effects of the composition according to the invention is a composition comprising an encapsulated antifungal compound having an inhibitory effect on fungal or bacterial spoilage including spoilage caused by *Bacillus* spp. (ropiness) of baked products including yeast leavened bakery products. Even if a mould inhibiting agent is selected for such a purpose which has a relatively low inhibitory effect on baker's yeast, it is well-known in the art that it is required to add a higher amount of yeast to a dough or batter composition when preserving agents are used as compared to dough or batter systems without preserving agent.

Particularly useful bread preserving agents are propionic acid and propionates, including sodium and calcium propionate which are used in bakery products to inhibit mould growth on or in the products after manufacturing. Typically, such anti-mould agents are added to bakery products in an amount in the range of 0.1 to 0.625 wt%, calculated on the flour. Accordingly, in one useful embodiment of the invention the edible composition comprises as the food additive component a propionate. It has surprisingly been found such an antimicrobial agent when added to a dough in the form of particles encapsulated with a fatty substance which melt during baking has a higher antimicrobial effect as compared to the same amount of the agent which is added as the non-encapsulated salt.

One further useful aspect of the invention is that it provides the means of deferring the effect of a texture or consistency controlling compound present in the food system until at a point in time during the processing of the food system where it is desired that such an effect occurs.

One typical example where such a deferment is advantageous is a food system where it is desired to obtain a gelling or an increased viscosity towards the end of the processing whereas the occurrence of gelling or increase in viscosity is undesirable during the initial stages of the processing. Typical food gelling agents include high methoxyl pectin, low methoxyl pectin, carrageenan, agar-agar and alginate. For each of these gelling agents there are specific conditions which causes the gelling to occur: high methoxyl pectins gel at pH values below 4 (in the presence of high amount of soluble solids), low methoxyl pectins in the presence of Ca^{2+}, carrageenan in the presence of K^{+} or Ca^{2+}, agar-agar at temperatures below 32-39°C and alginates at pH below 4 or presence of Ca^{2+}.

In useful embodiments, the composition according to the invention comprises as the food additive component a compound which, when brought into contact with a second component texture or consistency controlling compound causes an undesirable or untimely texture or consistency alteration to occur including a food additive component which causes a potential gelling or viscosity enhancing agent to alter the texture or consistency at an undesired point of time during processing of the food system.

Specifically, the food additive component can be an agent which causes a gelling agent to gel such as a metal salt or an acidulant. In this context useful metal salts include alkaline or earth alkaline metal salt which are soluble in an aqueous food system such as sodium, potassium and calcium salts. Useful acidulants can e.g. be selected from edible organic acids such as citric acid, lactic acid, malic acid, tartaric acid or acetic acid.

It will be understood that the above deferment of an undesirable effect of a food additive component may also be obtained by providing the component in the edible composition according to the invention as the encapsulated food additive compo-

nent which will thereby be prevented from interacting with a protein at a pH where precipitation of the protein normally occurs. Such an embodiment is i.a. useful in the manufacturing of acidified milk products where stabilizing agents such as e.g. pectins are added. Presently, pectin is not added to such food systems until after acidification in order to avoid undesired precipitation of milk protein at an early stage of the processing.

It will be understood that any of the above food additives for which it may be desirable to defer the food additive effect in a controlled manner until at a pre-selected point in time during the processing of the food system so as to avoid or prevent an undesired effect on any other components of the food system will be encompassed by the present invention. Accordingly, the edible composition may as the encapsulated food additive comprise any antioxidant, sweetener, flavouring agent, colour, preservative, enzyme, nutritive additive such as a vitamin and a mineral, emulsifier, pH control agent such as an acidulant, hydrocolloid, antifoam and release agent, flour improver and raising agent, gas generating compound and chelating agent.

Thus, a further example of application of a composition according to the invention is to provide or control enzymatic activities in a food system or in a finished food product during storage hereof, whereby one or more of the enzymes, its substrate and possibly co-factors or enzyme inhibitors are incorporated in encapsulated form into the composition whereby the enzymatic activity is not initiated or possibly inhibited until the encapsulation is degraded during processing of the food system. Examples of such enzymatic activities may be enzymes which contribute to the maturation of cheese, but whose activity is undesirable in the cheese milk, or enzymes which have a starch degrading or a hemicellulose degrading activity in a dough but for which it is desired to defer the effect until during the baking process.

Examples of such dough improving enzymes include hemicellulases or xylanases and amylases. However, when such enzymes or allowed to be active during the process of preparing a dough their activity may result in an undesirable development in the dough of "stickiness". Accordingly, it is advantageous to defer the enzymic activity until the dough has been prepared, i.e. until the baking process is initiated. Evidently, the present invention provides the means of such a deferred or controlled release of the effect of dough improving enzymes.

The primary objective of providing the food additive component of the composition as encapsulated particles is, as it is mentioned above, to prevent or avoid any undesired effect the food additive may have in the food system on any other component present in the food system such that the release of the desired effect of the food additive is deferred until at a selected point in time during processing and/or storage of the finished food product resulting from the processing. The term "selected point in time" indicates that the type of encapsulating component and the amount of the layer of this component is selected so as to control during the processing of the food system the point in time where the encapsulation is disintegrated, degraded or broken down to release the food additive to provide the desired effect hereof. The conditions under which the degradation of the encapsulation structure is effected depends on the type of the encapsulating component(s) of the encapsulation. When a water soluble encapsulating component is used, the degradation will be triggered by adding the composition to an aqueous phase. When the encapsulating component is a fatty substance, the degradation of the component will occur as a result of heating the food system, the point in time when this occurs depending on the melting point of the substance and the amount of the encapsulating layer of the substance.

In accordance with the invention, it is therefore possible to select fatty encapsulating substances having varying melting points in the range of 20 to 100°C, such as e.g. having

melting points which is at least 30°C, e.g. in the range of 50 to 90°C including the range of 60 to 80°C.

In other embodiments, the degradation of the encapsulation structure results from the activity of an enzyme being present and active in the food system during processing, or from changes of the chemical or physical conditions occurring in the food system during processing or in the finished food product during storage. Examples of such changes include changes of pH, water activity or enzymatic activity.

Examples of useful encapsulating components include edible fatty components, hydrocolloids and polymers.

Of the above components, fatty substances are particularly preferred. Suitable fatty substances include monoglycerides, diglycerides, mono/diglycerides and triglycerides of edible fatty acids, or mixtures hereof. Mono- and diglycerides can be further esterified with other organic acids such as acetic acid, lactic acid, diacetyl tartaric acid or citric acid. The edible fatty acids of the above mono-, di- or triglycerides and esterified mono- or diglycerides may be saturated or unsaturated fatty acids containing e.g. 6 to 22 carbon atoms such as 14 to 22 carbon atoms. By using glycerides with differing fatty acid chain lengths and degrees of saturation, the melting point of the encapsulating component can be preselected. In preferred embodiments, the glyceride is an acylated glyceride, particularly useful substances being succinylated or acetylated glycerides (also referred to as acetoglycerides) including acetylated monoglycerides. It is also contemplated that lecithins can be used as the encapsulating component. Useful encapsulating compounds also include sucrose esters of edible fatty acids, polyglycerol esters of edible fatty acids, sodium or calcium stearoyl lactylate, sorbitan esters of edible fatty acids such as e.g. sorbitan monostearate and sorbitan tristearate, and propylene glycol esters of edible fatty acids.

It will be appreciated by the person skilled in the art that the term "monoglyceride" includes different species in respect of the fatty acid radical. Thus, the term will include commercial products comprising a mixture of monoglyceride species such as species comprising a range of C_6 to C_{22} fatty acid groups.

In accordance with the invention, further useful encapsulating compounds include edible waxes such as carnauba wax, candelilla wax and bees wax.

Although edible fatty components are particularly suitable for providing the encapsulating structure of the edible compositions of the invention, it is also possible to provide an encapsulating structure that, in addition to the fatty component, comprises a hydrocolloid and/or a polymer including those mentioned in the following. In such a mixed structure, the fatty component typically comprises at least 25 wt% such as at least 50 wt% including at least 75 wt%.

During the experimentation leading to the invention it has been found that the presence of a hydrophilic substance which in itself does not provide an encapsulating structure in the encapsulation can improve the characteristics of the encapsulation such as the provision of a more dense structure and improved disintegration characteristics. Examples of hydrophilic substances for which such an advantageous effect is contemplated include glycerol, polyglycerols, polysorbates such as polyoxyethylene sorbitan esters of edible fatty acids. In useful embodiments, the amount of such a hydrophilic substance in the encapsulating structure is in the range of 0.1 to 25 wt% including the range of 0,5 to 20 wt%. In specific embodiments the amount of the hydrophilic substance is up till and including 1 wt% of the encapsulating structure.

Other useful encapsulating components according to the invention include protein hydrocolloids of animal origin such as

gelatin and carbohydrate hydrocolloids of plant or microbial origin. This group of hydrocolloids are generally grouped as linear (cellulose, amylose, pectin, carrageenan, alginate and agar), single branch (dextran), substituted linear (locust bean gum, guar gum) and branch-on-branch (amylopectin, gum arabic) hydrocolloids. The encapsulating component can also be one of such hydrocolloids which is chemically modified such as e.g. carboxymethyl cellulose (CMC), cellulose acetate butyrate, or modified starches, including as an example a starch adipate.

It is also contemplated that edible polymers such as e.g. polyvinylpyrrolidone, polyethylene wax, ethylene/vinyl acetate copolymer or phthalate compounds, can be used in accordance with the invention as the encapsulating compound.

In accordance with the invention, the food additive component of the edible composition is in the form of encapsulated particles. A suitable size of such particles in terms of their largest average diameter is in the range of 50 μm to 5000 μm such as e.g. in the range of 50 μm to 4000 μm, including the range of 50 μm to 3000 μm and the range of 50 μm to 2000 μm, such as 100 to 1000 μm including 200 to 500 μm.

It was found that for certain purposes such as use of a composition according to the invention in a flour dough system, it may be advantageous that not more than 10% of the particles have an average largest particle diameter which exceeds 450 μm and/or that not more than 30% of the particles have an average largest particle diameter which is less than 100 μm.

In the composition according to the invention, the appropriate amount of encapsulating component will i.a. depend on the particle size of the food additive, the type and characteristics of the encapsulating component itself, e.g. its melting point, and the stage of the food system processing where it is desired to have the food additive and its effect released.

Generally, the proportion of the encapsulating component is in the range of 5 to 95 wt% of the composition, e.g. in the range of 10 to 80 wt% including the range of 20 to 60 wt% such as e.g. about 40 to 50 wt%. For certain purposes it is advantageous that the proportion of encapsulating structure is less than 67 wt% of the composition.

It will be understood that the composition according to the invention may contain any further components which are useful as ingredients in a food system and which the skilled artisan can readily select. Thus, the composition may be provided as a dry or a pourable aqueous pre-mix for a particular type of food system comprising one or more ingredients typically used in such a food system. An example hereof is a dough ingredient pre-mix additionally containing conventional dough ingredients such as oxidizing agents, salt, emulsifiers, dough improving agents such as enzymes, e.g. selected from starch degrading enzymes, hemicellulases, xylanases, oxidoreductases and lipases.

In another aspect, the invention relates to a dough improving composition comprising a dough additive component that is in the form of particles encapsulated by an encapsulating structure as described above. As used herein, the expression "dough additive component" includes any conventionally used agents including those mentioned above such as additives that limit the function of yeast cells that are included in the dough system as a leavening agent. Other additives which can be used in the composition includes enzymes that have an improving effect on the dough properties or those of the finished products including baked products. In one specific embodiment, the dough additive is a preserving agent such as propionic acid or a salt hereof including calcium propionate, benzoic acid or a salt thereof, parabens, sorbic acid or sorbates, a bacteriocin or any mixture of such agents.

Thus, in useful embodiments the dough improving composition is one which, when it is added to a yeast-containing dough,

results in that a leavening effect as determined by the specific volume of the baked product is obtained which is the same as that obtained in a dough of an essentially identical composition but where the dough additive component is not encapsulated, and processed under essentially identical conditions, which contains an amount of yeast that is at least 20% higher such as at least 25% higher, e.g. at least 40% higher, or it is a composition which, when it is added to a dough, results in an extension of the time period where the baked product is not attacked by spoilage microorganisms such as fungal species or bacteria, which is at least one day as compared to a baked product made from an essentially identical dough that is processed under essentially identical conditions, but where the preserving agent is not encapsulated.

The dough improving composition of the invention may, as mentioned above, comprise as the dough improving additive, an enzyme that has an improving effect on the dough properties and the properties of the finished product. As examples such an enzyme include a hemicellulase such as a xylanase, a xylosidase and an alpha-glucoronidase, a starch degrading enzyme, a lipase, a protease and an oxidoreductase such as glucose oxidase or hexose oxidase.

In other embodiments the dough improving composition comprises both a preserving agent and a dough improving enzyme. These two additives can be encapsulated in one and the same particle or they can be encapsulated separately such that the composition comprises a mixture of particles.

The encapsulated food additive component of the composition according to the invention is typically provided by admixing the active food additive component with the encapsulating component under conditions where the encapsulating component is in a liquid or dissolved state followed by subjecting the mixture to a process step permitting the encapsulating component to become solid. Such a process step may e.g. be a spray

drying step, a spray cooling step, a drying step or a chemical treatment causing the encapsulating component to become a coherent solid layer surrounding the active food additive component and/or second component.

Thus, the food additive component is typically provided by processes which in the art are generally referred to as matrix coating and layered coating methods, the latter method being performed in fluid bed equipment in which the particles of food additive is coated or encapsulated by spraying the encapsulating component onto the fluidized particles.

In a further aspect, the invention pertains to a method of producing a food product, comprising processing a food system comprising a composition according to the invention and at least one component on which the food additive component has an undesired effect, under conditions where the encapsulation is degraded at a later point in time under pre-selected conditions during the processing of said food system, whereby, as a result of the food additive component initially being encapsulated, the undesirable effect on the second component can be avoided at least during part of the processing time for said food system.

The conditions under which degradation of the encapsulation structure occurs include heating which e.g. will cause a fatty encapsulating component to melt. Typical examples hereof is the heating conferred to a bread dough during the baking hereof or the heating of a fruit preserve, marmalade, jam or jelly system. Such conditions may also include a slow or controlled dissolution of the encapsulating component in the aqueous phase of the food system during processing of the system or during storage of the finished food product. The encapsulation component may also be one which causes the encapsulation to become degraded under particular pH conditions in which case the degradation will occur either during processing if a pH change occurs or during storage of the finished food product during which a pH change takes place.

Thus, in useful embodiments, the method according to the invention is a method wherein the food system is a batter or a dough or a food system which is selected from the group consisting of a meat product mixture, a milk-derived product, a fruit product mixture and a vegetable product.

EXAMPLE 1

Preparation of a composition comprising encapsulated calcium propionate

A composition comprising encapsulated calcium propionate was prepared by mixing under stirring equal parts (weight) of calcium propionate and a molten commercial distilled monoglyceride (DIMODAN® PVP, Danisco Ingredients, Brabrand, Denmark) of edible fatty acids made from fully hydrogenated palm oil having an iodine value of at the most 2 and a dropping point of about 69°C.

The resulting mixture was spray cooled to obtain matrix coated particles of calcium propionate having an average largest particle diameter of about 300 μm.

EXAMPLE 2

Preparation of an "80% sponge and dough" white pan bread

The basic recipe for the sponge was the following (figures in bracket are Baker's %):

Dawn Premium Patent Flour	1600 g	(80.0)
Sodium stearoyl lactylate (SSL)	8 g	(0.5)
Instant dry yeast	22 g	(1.1)
Water	1014 g	(51.0)

The basic recipe for the dough was the following:

Dawn Premium Patent Flour	400 g	(20.0)
Salt	40 g	(2.0)
Instant dry yeast	14 g	(0.7)
High fructose corn syrup (HFCS)	240 g	(12.0)
Soybean oil	60 g	(3.0)
Ascorbic acid (1:99 aqueous sol.)	12 g	
Water	146 g	(7.5)
PANODAN® 205[a)]	10 g	(0.5)

a) diacetyl tartaric acid ester of monoglyceride

Three test batches of the sponge/dough were prepared in which the above ingredients were supplemented with (wt% based on the weight of flour):

(i) 0.25 wt% calcium propionate and 0.5 wt% DIMODAN® ES K (distilled monoglyceride of edible fatty acids made from refined, partially hydrogenated vegetable oil having an iodine value of at least 22 and a dropping point of about 69°C) (Test 1);

(ii) 0.25 wt% calcium propionate and 0.5 wt% DIMODAN® ES K and 0.44 wt% of instant dry yeast (increase of 40% as compared to test 1 and test 3) (test 2);

(iii) 0.25 wt% DIMODAN® ES K and 0.5 wt% of the composition of Example 1 (test 3).

The sponge component was prepared by mixing the ingredients for 1 minute at low agitation followed by mixing for 3 minutes at medium agitation. The mixture was allowed to ferment for 3 hours. The dough component was prepared by mixing the dough ingredients for 1 minute at low agitation followed by 14 minutes at medium agitation. The two components were mixed and the sponge and dough mixture was allowed to rest for 5 minutes followed by scaling to dough pieces of 13 ounces each which were allowed to rest for 5 minutes. The dough pieces were sheeted following by proofing for 60 minutes at 40.5°C/85°RH. The rested dough was baked at 218°C for 18 minutes.

The baked bread was tested for specific volume (ml per g) using the conventional rape seed replacement method.

The bread was allowed to cool for 60 minutes and subsequently sliced and bagged. The sliced loaves were then stored at ambient temperature and inspected visually for the occurrence of mould growth. The results of the tests are summarized in the below Table 2.1.

Table 2.1. Specific volume and No. of days to mould of sponge/dough bread test batches 1-3.

Test No.	Specific volume	Days to mould
1	5.82	12
2	6.56	13
3	6.29	16

In all tests, there was no significant difference in dough handling characteristics and machinability, and the bread cell structure and crust colours were comparable.

The results demonstrated that test 3 where the same amount of instant dry yeast was added as in test 1 had a significantly improved specific volume effect over test 1. Since the only difference between test 1 and test 3 was that the calcium propionate in test 3 was in form of the encapsulated composition it is reasonable to assume that the improved effect is ascribable to the fact that the yeast in test 3 was not in contact with the calcium propionate while it was active with respect to leavening activity.

In fact, it can be seen from the above results that the encapsulation of calcium propionate can compensate for a 40% increase of the amount of yeast (test 2).

Additionally, it was observed that the same amount of calcium propionate in test 2 and test 3, respectively, had a different mould inhibiting effect. In the bread where the calcium propionate is in the encapsulated form, a significant increase in days to mould was found (16 vs. 13 days). Based on these findings, it may be suggested that the matrix coating of the calcium propionate protects this mould inhibiting substance from loosing part of its anti-mould effect.

EXAMPLE 3

Preparation of "straight dough" white pan bread

The basic recipe for the dough was the following (figures in brackets are Baker's %):

Dawn Premium Patent Flour	2000 g	(100.0)
Salt	40 g	(2.0)
Instant dry yeast	36 g	(1.8)
High fructose corn syrup (HFCS)	300 g	(15.0)
Non fat dry milk (NFDM)	80 g	(4.0)
Soybean oil	80 g	(4.0)
Ascorbic acid (1:99 aqueous sol.)	12 g	
Water	1160 g	(58.0)

Total absorption: 62.5%

Three test batches of the straight dough were prepared in which the above ingredients were supplemented with (wt% based on the weight of flour):

(i) 0.35 wt% calcium propionate and 0.35 wt% DIMODAN® ES K (Test 1);

(ii) 0.35 wt% calcium propionate and 0.35 wt% DIMODAN® ES K and 0.72 wt% of instant dry yeast (increase of 40% compared to test 1) (test 2);

(iii) 0.70 wt% of the composition of Example 1 (test 3).

The dough component was prepared by mixing the dough ingredients for 1 minute at low agitation followed by 13 minutes at medium agitation and the dough mixture was then allowed to rest for 5 minutes followed by scaling to dough pieces of 13 ounces each which were allowed to rest for 5 minutes. The dough pieces were sheeted following by proofing for 60 minutes at 40.5°C/85°RH. The rested dough was baked at 218°C for 18 minutes.

The baked bread was tested for specific volume (ml per g) using the conventional rape seed replacement method.

The bread was allowed to cool for 60 minutes and subsequently sliced and bagged. The sliced loaves were then stored at ambient temperature and inspected visually for the occurrence of mould growth. The results of the tests are summarized in the below Table 3.1.

Table 3.1. Specific volume and No. of days to mould of straight dough bread test batches 1-3.

Test No.	Specific volume	Days to mould
1	6.76	10
2	7.49	12
3	7.36	13

Also in these tests, there was no significant difference in dough handling characteristics and machinability, and the bread cell structure and crust colours were comparable.

The results affirmed the results obtained in Example 2, i.e. it was demonstrated that test 3 where the same amount of instant dry yeast was added as in test 1 had a significantly improved specific volume effect over test 1 and that the encapsulation of calcium propionate can compensate for a 40% increase of the amount of yeast (test 2).

Additionally, it was observed that calcium propionate in the encapsulated form showed an increase in days to mould (13 vs. 10 or 12 days).

CLAIMS

1. An edible composition comprising a food additive component which, when it is brought into contact with a second component present in a food system to be processed, at least during part of the processing time, has an undesirable effect on said second component, said food additive component being in the form of particles encapsulated by an encapsulation structure preventing that the food additive initially is brought into contact with the second component, the encapsulation being degradable at a later point in time under preselected conditions during the processing of said food system, whereby, as a result of the food additive component initially being encapsulated, the undesirable effect on the second component can be avoided at least during part of the processing time for said food system, said encapsulating structure comprising an edible fatty component comprising a hydrophilic substance which does not in itself provide an encapsulation but which improves the characteristics of the encapsulation.

2. A composition according to claim 1 wherein the edible fatty component is a fatty substance selected from the group consisting of a monoglyceride of an edible fatty acid, a diglyceride of an edible fatty acid, a diglyceride of an edible fatty acid, a triglyceride of an edible fatty acid, a mixture of such glycerides, a polyglycerol ester of an edible fatty acid, a propylene glycol ester of an edible fatty acid, a sorbitan ester of an edible fatty acid, a stearoyl lactylate, a sucrose ester of an edible fatty acid, a diacetyl tartaric acid ester of a mono- or diglyceride of an edible fatty acid, a citric acid ester of a mono- or diglyceride of an edible fatty acid and an acetic acid ester of a mono- or diglyceride of an edible fatty acid.

3. A composition according to claim 1 wherein the edible fatty component is a monoglyceride.

4. A composition according to claim 1 wherein the edible fatty component has a melting point of at least 30°C.

5. A composition according to claim 4 wherein the edible fatty component has a melting point of at least 50°C.

6. A composition according to claim 1 wherein the hydrophilic substance is selected from the group consisting of a glycerol, a polyglycerol and a polysorbate.

7. A composition according to claim 1 wherein the amount of the hydrophilic substance in the encapsulating structure is in the range of 0.1 to 25 wt% including 0.5 to 20 wt%.

8. A composition according to claim 7 wherein the amount of the hydrophilic substance in the encapsulating structure is up till and including 1 wt%.

9. A composition according to claim 1 wherein the food additive component is a compound which limits the function of viable cells.

10. A composition according to claim 9 wherein the food additive component is a compound having an inhibitory or biocidal effect on second component viable microbial cells.

11. A composition according to claim 10 wherein the food additive component is a preserving agent.

12. A composition according to claim 11 wherein the preserving agent is selected from the group consisting of propionic acid, a propionate, benzoic acid, a benzoate, a paraben, sorbic acid, a sorbate, a bacteriocin and any mixture of such agents.

13. A composition according to claim 10 wherein the second component viable microbial cells on which the first component compound has an inhibitory or biocidal effect are cells

selected from the group consisting of a yeast species and a lactic acid bacterial species.

14. A composition according to claim 1 wherein the food additive component is a compound which, when brought into contact with a second component texture or consistency controlling compound causes an undesirable or untimely texture or consistency alteration to occur.

15. A composition according to claim 14 wherein the food additive component is a compound which causes a potential gelling or viscosity enhancing agent to alter the texture or consistency of a food system at an undesired point of time during processing of the food system.

16. A composition according to claim 15 wherein the food additive component is a metal salt or an acidulant.

17. A composition according to claim 16 wherein the metal salt is selected from an alkaline or earth alkaline metal salt.

18. A composition according to claim 1 wherein the food additive component is an enzyme.

19. A composition according to claim 18 wherein the enzyme is selected from the group consisting of a hemicellulase, a xylanase, a starch degrading enzyme and an oxidoreductase.

20. A composition according to any of claims 1-19 wherein the encapsulating structure further comprises an edible hydrocolloid and/or an edible polymer.

21. A composition according to claim 1 wherein the food additive component is in the form of encapsulated particles having an average largest diameter in the range of 50 μm to 5000 μm.

22. A composition according to any of claims 1-21 wherein the proportion of the encapsulating structure is in the range of 5 to 95 wt% of the composition.

23. A composition according to claim 22 wherein the proportion of the encapsulating structure is less than 67% of the composition.

24. A method of producing a food product, comprising processing a food system comprising a composition according to any of claims 1-23 and one or more further component(s) on which the food additive component of the composition has an undesirable effect, under conditions where the encapsulation is degraded at a later point in time under pre-selected conditions during the processing of said food system, whereby, as a result of the food additive component initially being encapsulated, the undesirable effect on the second component can be avoided at least during part of the processing time for said food system.

25. A method according to claim 24 wherein the food system is a yeast-containing dough composition.

26. A method according to claim 25 wherein the food additive component is a compound having an inhibitory effect on yeast cells and/or bread spoilage organisms including *Bacillus* species and fungi.

27. A method according to claim 26 wherein the food additive component is a propionate.

28. A method according to claim 24 wherein the food system is for producing a fruit-containing food product including a jelly, a preserve and or a marmalade.

29. A method according to claim 28 wherein the food additive component is a metal salt including an alkaline or an earth alkaline metal salt.

30. A method according to claim 24 which includes the addition of lactic acid bacterial starter culture and providing conditions where said culture is metabolically active.

31. A method according to claim 24 wherein the food additive component is an enzyme.

32. A method according to claim 31 wherein the enzyme is selected from the group consisting of a hemicellulase, a xylanase, a starch degrading enzyme and an oxidoreductase.

33. A method according to claim 24 wherein the food additive component is a stabilizing or gelling agent.

34. A dough improving composition comprising a dough additive component which, when it is brought into contact with a second component present in a dough system to be processed, at least during part of the processing time, has an undesirable effect on said second component, said dough additive component being in the form of particles encapsulated by an encapsulation structure preventing that the dough additive initially is brought into contact with the second component, the encapsulation being degradable at a later point in time under pre-selected conditions during the processing of said food system, whereby, as a result of the dough additive component initially being encapsulated, the undesirable effect on the second component can be avoided at least during part of the processing time for the dough, said encapsulating structure comprising an edible hydrocolloid, an edible polymer and/or an edible fatty component comprising a hydrophilic substance which does not in itself provide an encapsulation but which improves the characteristics of the encapsulation.

35. A composition according to claim 34 wherein the edible fatty component is a fatty substance selected from the group consisting of a monoglyceride of an edible fatty acid, a diglyceride of an edible fatty acid, a diglyceride of an

edible fatty acid, a triglyceride of an edible fatty acid, a mixture of such glycerides, a polyglycerol ester of an edible fatty acid, a propylene glycol ester of an edible fatty acid, a sorbitan ester of an edible fatty acid, a stearoyl lactylate, a sucrose ester of an edible fatty acid, a diacetyl tartaric acid ester of a mono- or diglyceride of an edible fatty acid, a citric acid ester of a mono- or diglyceride of an edible fatty acid and an acetic acid ester of a mono- or diglyceride of an edible fatty acid.

36. A composition according to claim 34 wherein the edible fatty component is a monoglyceride.

37. A composition according to claim 34 wherein the edible fatty component has a melting point of at least 30°C.

38. A composition according to claim 37 wherein the edible fatty component has a melting point of at least 50°C.

39. A composition according to claim 34 wherein the proportion of the encapsulating structure is in the range of 5 to 95 wt% of the composition.

40. A composition according to claim 34 wherein the proportion of the encapsulating structure is less than 67% of the composition.

41. A composition according to claim 34 wherein the hydrophilic substance is selected from the group consisting of a glycerol, a polyglycerol and a polysorbate.

42. A composition according to claim 41 wherein the amount of the hydrophilic substance in the encapsulating structure is in the range of 0.1 to 25 wt% including 0.5 to 20 wt%.

43. A composition according to claim 42 wherein the amount of the hydrophilic substance in the encapsulating structure is up till and including 1 wt%.

44. A composition according to claim 34 wherein the dough additive component is a compound which limits the function of yeast cells.

45. A composition according to claim 44 wherein the dough additive component is a preserving agent selected from the group consisting of propionic acid, a propionate, benzoic acid, a benzoate, a paraben, sorbic acid, a sorbate, a bacteriocin and any mixture of such agents.

46. A composition according to claim 45 which, when it is added to a yeast-containing dough, results in that a leavening effect as determined by the specific volume of the baked product is obtained which is the same as that obtained in a dough of an essentially identical composition but where the dough additive component is not encapsulated, and processed under essentially identical conditions, which contains an amount of yeast that is at least 20% higher.

47. A composition according to claim 45 or 46 which, when it is added to a dough, results in an extension of the time period where the baked product is not attacked by spoilage microorganisms which is at least one day as compared to a baked product made from an essentially identical dough that is processed under essentially identical conditions, but where the preserving agent is not encapsulated.

48. A composition according to claim 34 wherein the dough additive is a dough improving enzyme.

49. A composition according to claim 48 wherein the enzyme is selected from the group consisting of a hemicellulase, a xylanase, a starch degrading enzyme and an oxidoreductase.

50. A composition according to claim 34 which as the dough additive comprises a preserving agent as defined in claim 45 and an enzyme as defined in claims 48-49.

51. A composition according to claim 50 wherein the two dough additives are encapsulated in one particle.

52. A composition according to claim 50 wherein the two dough additives are encapsulated separately.

53. A composition according to claim 21 or 34 wherein at the most 30% of the particles of encapsulated food additive component or dough additive component have an average largest particle diameter which is less than 100 μm.

54. A composition according to any of claims 21, 34 or 53 wherein at the most 10% of the particles of encapsulated food additive component or dough additive component have an average largest particle diameter which exceeds 450 μm.

55. A method of preparing a baked product, said method comprising that a composition according to any of claims 34-54 is added to a dough, and baking the dough.

INTERNATIONAL SEARCH REPORT

Inter onal Application No
PCT/DK 98/00357

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 A23P1/04 A21D2/14

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 A23P A21D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 3 956 173 A (G.A.TOWLE) 11 May 1976 see column 1, line 59 - column 2, line 14 see column 3, line 49-56; claims; examples	1-55
A	US 3 622 350 A (P.A.HAMMES) 23 November 1971 see claims; examples	1-55
A	GB 1 458 625 A (DISTILLERS COMPANY(YEAST)) 15 December 1976 see the whole document	1-55
A	EP 0 030 448 A (PROCTER & GAMBLE) 17 June 1981 see page 2, line 25-36; claims	1-55

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

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"P" document published prior to the international filing date but later than the priority date claimed

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Date of the actual completion of the international search	Date of mailing of the international search report
27 November 1998	04/12/1998

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INTERNATIONAL SEARCH REPORT

Inter onal Application No
PCT/DK 98/00357

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication.where appropriate, of the relevant passages	Relevant to claim No.
A	DATABASE WPI Section Ch, Week 8230 Derwent Publications Ltd., London, GB; Class B05, AN 82-62831E XP002048079 & JP 57 100179 A (NIPPON GOSEI KAGAKU KOGYO KK), 22 June 1982 see abstract	1-55
A	WO 96 22676 A (M-CAP TECHNOLOGIES) 1 August 1996 see page 4, line 15-27 see page 8, line 4-26 see claims	1-55

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INTERNATIONAL SEARCH REPORT

information on patent family members

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PCT/DK 98/00357

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